Analysis on age structure of *Zoysia japonica* (Poaceae) population

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Abstract: The age-structure of natural population of *Zoysia japonica* in Xiuyan County of Liaoning Province was studied by generational method. The results showed that the highest tiller age class was three, but 1st age class tillers held dominant position with proportions over 95% in each month during the growing seasons. The 2nd age class and 3rd age class tillers were minority in the population. So *Z. japonica* population was an expanding population. The zero age class buds on the rhizomes were dominant in buds age structures. The proportion of buds to tillers on quantity in each month was about 30% to 40% and reached the highest at the end of September. The increasing of buds proportion before dormancy guaranteed the quantity of tillers in the next spring. The biomass of 1st age class tillers changed with time. The biomass kept increasing from April to July and reached the highest at the end of July and then decreased.

Keywords: *Zoysia japonica*; Age structure; Clonal population

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Introduction

The study of clonal population has been paid more attention as the development of ecology (Harberd 1961; Vasek 1980; Schmud 1987). Age structure, which means the number distribution of different age groups in a population, is an important character of population. In fact, research on the clonal population is very difficult, especially for clonal herbs, but if we want to understand the present status and future tendency of a clonal population, a study on the age structure is necessary. From the birth and death of ramets we can understand the life span and the turnover of generations and reveal why clonal herb population is longevous.

Zoysia japonica is widely distributed in China. It is a typical rhizome herb, and asexual propagation is its main reproductive way. It often forms single dominant community naturally. Natural *Z. japonica* meadow is used to be a pasture and *Z. japonica* also is widely used in the world as an excellent turf grass. There were many reports on age structure of clonal herbs (Wang *et al.* 1993, Yang *et al.* 1995, 1997, 1998, 2000). But up to now there is no published information on the age structure of *Z. japonica* population. This study was initiated to analyze the age structure of tiller and bud as well as biomass change of *Z. japonica* in growing seasons. Our study may give some information to understand the life history of *Z. japonica*.

Materials and methods

Experiment material

The samples were taken from natural population of *Z. japonica* in Xiuyan County of Liaoning Province on the 27th of each month from April to September in 2000. Three samples were collected from each sample plot in each month. Each sample size was 25 cm×25 cm. All the components above and under ground (including tillers, rhizomes and roots) were dug out and washed gently to get rid of soil. Attention was paid to keeping the natural connection of each part to meet the requirement of age judgment.

The age differentiation method was to refer to the generation method proposed by Yang Yunfei (Yang *et al.* 1998).

Measurement of tillers productivity

One hundred mature tillers (1st age class) were chosen randomly from each sample and dried at 85 °C until the difference between the weights of 2 times for the same sample was less than 5 mg.

Data disposal

First, the quantity indexes in the area of 25 cm×25 cm were transformed to those in the area of 1 m×1 m. The age structure was expressed by $M+/-S_D$.

M—the mean value of 3 samples

S_D—the standard variance to give a variation among samples

The age structure was also expressed by the specific

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value of the quantity of each age ingredients to the total quantity.

Growth rate (G_R) means the biomass increase of tillers between 2 neighboring months.

$G_R=(W_2-W_1)/W_1\times100\%$

W_1—the tiller weight in the front month

W_2-- the tiller weight in the next month

Results and analysis

Tiller's age structure

Age structure means the rate of different age class tillers to the total quantity of tillers. In this study, tillers included both branches developed from the nodes of rhizome and tillers developed from tiller-nodes of branches. Table 1 showed that the highest age class of tiller was three. 1st age class tillers had the highest rate. The rate of 2nd age class tillers decreased rapidly. 3rd age class tillers only existed in July and August. So July and August were the active period for *Z. japonica* to reproduce offspring. From April to September 1st age class tiller kept a rate over 95%, the branches seldom produced next generation tillers. From the structure we can see that *Z. japonica* population belong to increasing population. The fluctuation of tiller's age structure during the growth months was not obvious, which means the tiller population of *Z. japonica* was stable in the whole growing season. The quantity of total tillers kept at a high level in the growing season. The highest number of tillers was 10 437.3 individual/m^2 in August. *Z. japonica* always grows very densely and forms single dominant community. The tiller number in April was lower than that in September. About 29% of the tillers died during the winter.

Biomass change tendency of tillers

The seasonal change tendency of 1st age class tiller's biomass was the most important because 1st age class tillers were dominant in each month. The results from April to September were shown in Table 2 and Fig. 1. The biomass of 1st age class tiller increased from April to July and reached the highest in July, then decreased in August. The biomass in July is 105.5% more than that in June. The biomass in August was 32.7% less than that in July, which in September was 23.9% less than that in August.

Age structure of potential population

Z. japonica population could continually form buds in the whole growing seasons. The buds formed a potential population. Both the rhizomes and tillers could develop buds. The results were shown in Table 3. The zero age class buds (grow on the nodes and top of rhizomes) were dominant in each month. Their rates were over 90%. 1st age class bud rate was 1.3% in average and 2nd age class bud rate was 0.1%. This was consistent with the result that 1st age class tillers were dominant in the whole growing season. Zero age class buds will become 1st age class tillers in the future. 1st age class buds will turn into 2nd age class tillers then 2nd age class tillers develop from 3rd age class buds.

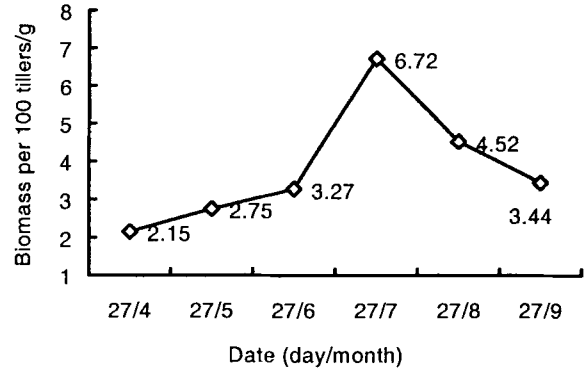

Fig.1 Tiller (1st age class) biomass (dry weight) change of natural *Z. japonica* clonal population

Table 1. Age structure (%) and tiller quantity of natural clonal population *of Z. japonica*

Date (day/month)	Age class			Total
	1st	2nd	3rd	
27/4	5584±843.7	16.0±13.1	0	5600
	99.7%	0.3%	0	100%
27/5	7941.3±2666.3	160.0±59.9	0	8101
	98.0%	2.0%	0	100%
27/6	8506.7±1196.9	240.0±47.1	0	8747
	97.3%	2.7%	0	100%
27/7	6373.3±1113.3	181.3±39.9	32.0±13.1	6587
	96.8%	2.7%	0.5%	100%
27/8	9936.0±741.9	480.0±52.3	21.3±7.5	10437
	95.2%	4.6%	0.2%	100%
27/9	7920.0±954.7	176.0±47.1	0	8096
	97.8%	2.2%	0	100%
Mean	7710.2	208.9	8.9	7928
	97.3%	2.6%	0.1%	100%

Table 3 showed that the rates of total buds to total tillers were stable at 30%-40% in the growing seasons. This guaranteed the stabilization of population. At the end of August the proportion of buds to tillers increased and

reached the highest in September (41.7%). This means that fewer buds develop to tillers and more buds are produced in autumn. These buds guaranteed the population to have a stable tiller number in the next spring. This is the evolutionary mechanism of *Z. japonica* to keep the sustaining of its population.

Table 2. Tiller (1st age class) productivity (100 tillers) of natural clonal population *of Z. japonica* each month

Date(day/month)	Biomass/g	G_R (%)
27/4	2.15	
27/5	2.75	27.9
27/6	3.27	18.9
27/7	6.72	105.5
27/8	4.52	-32.7
27/9	3.44	-23.9

Discussion

Z. japonica is widely used as turf grass in the world, particularly in Japan, Korea, China and America. Dense canopy is an outstanding character of *Z. japonica* turf. Our study showed that *Z. japonica* population had a very high density, 7928 tillers/m^2 in average naturally. *Aneurolepikium chinense* (Trin,) Kitag. is a clonal herb too, but its mean density is only 1200 tillers/m^2, (Yang *et al.* 1995). Fu Hongyi *et al.* (1998) reported that the biomass of *Aneurolepikium chinense* above ground rose before flowering and declined after seeded. *Z. japonica* tiller's biomass had the same changing tendency as *Aneurolepikium chinense*. The turf built by *Z. japonica* can be used for a long time. There is a *Z. japonica* turf that has been built over 100 years in Chongqing City, Sichuan Province of China and still lives in a good state. Why *Z. japonica* is so longevous? Our study showed that *Z. japonica* had an effectively reproductive mechanism. The components of *Z. japonica* population were always in a dynamic balance. Its rhizomes could grow continually and new buds were produced with it. Bud was a potential population and its rates to tillers were stable. When old tillers died, new tillers became from buds. In the autumn buds rate increased before dormancy. This guaranteed the stable of tillers number in the next spring. So the capacity of *Z. japonica* to produce new rhizomes, buds and tillers are everlasting. From these results the biological and ecological mechanism on sustaining renovation of *Z. japonica* population to expand and exist in a long time was revealed.

Table 3. Age structures and quantities of buds of natural *Z. japonica* clonal population each month

Date (day/month)	Age class 0	Age class 1st	Age class 2nd	Total	Rate of bud to tiller (%)
27/4	2214.0±654.6	26.7±7.5	0	2241	40.0
	99.0%	1.0%	0		
27/5	2501.3±1032.1	64.0±13.1	0	2565	31.7
	97.5%	2.5%	0%		
27/6	3082.7±1484.0	16.0±13.1	5.3±7.5	3104	35.5
	99.3%	0.5%	0.2%		
27/7	2133.3±516.7	80.0±13.1	16±13.1	2229	33.8
	95.7%	3.6%	0.7%		
27/8	3824.0±436.4	5.3±7.5	5.3±7.5	3835	36.7
	99.6%	0.2%	0.2%		
27/9	3338.7±554.9	32.0±13.1	5.3±7.5	3376	41.7
	98.9%	0.9%	0.2%		
Mean	2928.0	37.3	5.3	2971	37.5
	98.6%	1.3%	0.1%	100%	

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